

In the Claims:

Cancel claim 1.

1-27. (cancelled)

28. (new) An apparatus to provide image stabilization for a high-performance optical system with lens elements in a housing with gas-filled spaces between the lens elements, the apparatus comprising:

a heater arranged on an upper surface of the housing to provide a small thermal gradient with temperature increases in a vertical direction in one or more gas-filled spaces between the lens elements to create a stable thermal environment within the optical system.

29. (new) An apparatus according to claim 28 further includes an insulation layer arranged over at least a portion of the housing and arranged to facilitate the temperature change of the gas present within the one or more spaces to create a stable thermal environment within the optical system.

30. (new) An apparatus according to claim 28 further includes a gas manifold arranged adjacent a surface of the housing to flow gas around the housing surface to maintain a higher temperature on the upper surface of the housing.

31. (new) An apparatus according to claim 28 further includes a gas manifold to flow gas around the heater and located below the optical housing to prevent heating the lower surface of the housing to a temperature above the temperature on the upper surface of the housing.

32. (new) An apparatus according to claim 28 further includes a control unit electrically connected to the heater to control the operation thereof.

33. (new) An apparatus according to claim 32 further includes an indicator light coupled to the heater to indicate when the heater is activated.

34. (new) An apparatus according to claim 28 wherein the heater supplies between about 1 and 50 Watts of power.

35. (new) An apparatus according to claim 30 wherein the air manifold includes a hollow member with a plurality of apertures formed therein to provide distributed gas flow.

36. (new) An apparatus according to claim 29 wherein the insulating layer includes a blanket of Poron®.

37. (new) An apparatus according to claim 32 further includes an array of thermal sensors arranged over the housing in electrical communication with the control unit to provide temperature information of the housing to the control unit.

38. (new) An apparatus according to claim 32 further includes an array of thermal sensors arranged over the housing and in communication with the one or more spaces, and in electrical communication with the control unit, to provide temperature information of the gas in the gas-filled spaces to the control unit.

39. (new) An apparatus according to claim 28 wherein the insulating layer covers the heater.

40. (new) An apparatus according to claim 28 wherein the gas in the gas-filled spaces is air.

41. (new) An apparatus to provide image stabilization for a high-performance optical system with lens elements in a housing with gas-filled spaces

between the lens elements, the apparatus comprising:

a cooling element arranged on a lower surface of the housing to provide a small thermal gradient in the vertical direction in one or more gas-filled spaces between lens elements to create a stable thermal environment within the optical system.

42. (new) An apparatus according to claim 41 further includes an insulating layer arranged over at least a portion of the housing and arranged to facilitate the temperature change of the gas present within the one or more spaces to create a stable thermal environment within the optical system.

43. (new) An apparatus according to claim 41 further includes a gas manifold arranged adjacent a surface of the housing to flow gas around the housing surface to maintain a higher temperature on the upper surface of the housing.

44. (new) An apparatus according to claim 42 further includes a gas manifold to flow gas around the cooling element and located below the optical housing to prevent heating the lower surface of the housing to a temperature above the temperature on the upper surface of the housing.

45. (new) An apparatus according to claim 41 further includes a control unit electrically connected to the cooling element to control the operation thereof.

46. (new) An apparatus according to claim 45 further includes an indicator light coupled to the cooling element to indicate when the cooling element is activated.

47. (new) An apparatus according to claim 44 wherein the air manifold includes a hollow member with a plurality of apertures formed therein to provide distributed gas flow.

48. (new) An apparatus according to claim 43 wherein the insulating layer includes a blanket of Poron®.

49. (new) An apparatus according to claim 46 further includes an array of thermal sensors arranged over the housing in electrical communication with the control unit to providing temperature information of the housing to the control unit.

50. (new) An apparatus according to claim 46 further includes an array of thermal sensors arranged over the housing and in communication with the one or more spaces, and in electrical communication with the control unit, to provide temperature information of the gas in the gas-filled spaces to the control unit.

51. (new) An apparatus according to claim 42 wherein the insulating layer covers the heater.

52. (new) An apparatus according to claim 41 wherein the gas in the gas-filled spaces is air.

53. (new) A lithography system to pattern a wafer with an image of a mask, comprising:
an illumination system to irradiate the mask;
a microlithographic lens with one or more lens elements, and a housing to house the lens elements and to define gas-filled spaces between the lens elements;
a heater arranged on an upper surface of the housing to provide a small thermal gradient with temperature increases in the vertical direction in one or more gas-filled spaces between lens elements ; and
a wafer stage to support the wafer to be exposed with the image.

54. (new) A system according to claim 53 further includes an insulation layer arranged over at least a portion of the housing and arranged to facilitate the temperature change of gas present within the one or more spaces to create a stable thermal environment within the one or more spaces.

55. (new) A system according to claim 53 wherein the gas in the gas-filled space is air.

56. (new) An system according to claim 53 wherein the heater includes a gas manifold arranged adjacent a surface of the housing to flow a gas around the surface to maintain a higher temperature on the upper surface of the housing.

57. (new) An system according to claim 53 further includes a gas manifold to flow gas around the heater and located below the optical housing to prevent heating the lower surface of the housing to a temperature above the temperature on the upper surface of the housing.

58. (new) An system according to claim 53 further includes a control unit electrically connected to the heater to control the operation thereof.

59. (new) A lithography system to pattern a wafer with an image of a mask, comprising:

an illumination system to irradiate the mask;
a microlithographic lens with one or more lens elements, and a housing to house the lens elements and to define gas-filled spaces between the lens elements;
a cooling element arranged on a lower surface of the housing to provide a small thermal gradient in the vertical direction in one or more gas-filled spaces between lens elements; and
a wafer stage to support the wafer to be exposed with the image.

60. (new) A system according to claim 59 further includes an insulation layer arranged over at least a portion of the housing and arranged to facilitate the temperature change of gas present within the one or more spaces to create a stable thermal environment within the one or more spaces.

61. (new) A system according to claim 59 wherein the gas in the gas-filled space is air.

62. (new) An apparatus according to claim 59 further includes a gas manifold arranged adjacent a surface of the housing to flow a gas around the housing

surface to maintain a higher temperature on the upper surface of the housing.

63. (new) An apparatus according to claim 59 further includes a gas manifold to flow gas around the cooling element and located below the optical housing to prevent heating the lower surface of the housing to a temperature above the temperature on the upper surface of the housing.

64. (new) An apparatus according to claims 59 further includes a control unit electrically connected to the cooling element to control the operation thereof.

65. (new) A method for stabilizing the imaging of a high-performance optical system subject to thermal instability, comprising the step of:

heating a top portion of an optical system or cooling the bottom portion of the optical system so that gas in one or more gas-filled spaces of the optical system has a temperature gradient that increases the temperature from the bottom to the top of the optical system within the one or more gas-filled spaces to form a stable thermal environment within the gas-filled spaces.

66. (new) A method according to claim 65, further including the step of flowing gas over and around one or more heat-generating elements to prevent heat from the one or more heat-generating elements from heating the lower surface portion of the optical system to a temperature above the temperature on the upper portion of the optical system.

67. (new) A method according to claim 65, further including the step of detecting image instability in the optical system.

68. (new) A method according to claim 65 wherein the step of detecting image stability includes the step of measuring the temperature gradient across the gas filled spaces of the optical system.

69. (new) A method according to claim 67, wherein the step of detecting imaging instability includes the step of measuring locations of images from the optical system at different times.

70. (new) A method according to claim 69, further including the step of measuring overlay errors between first and second level exposure fields.

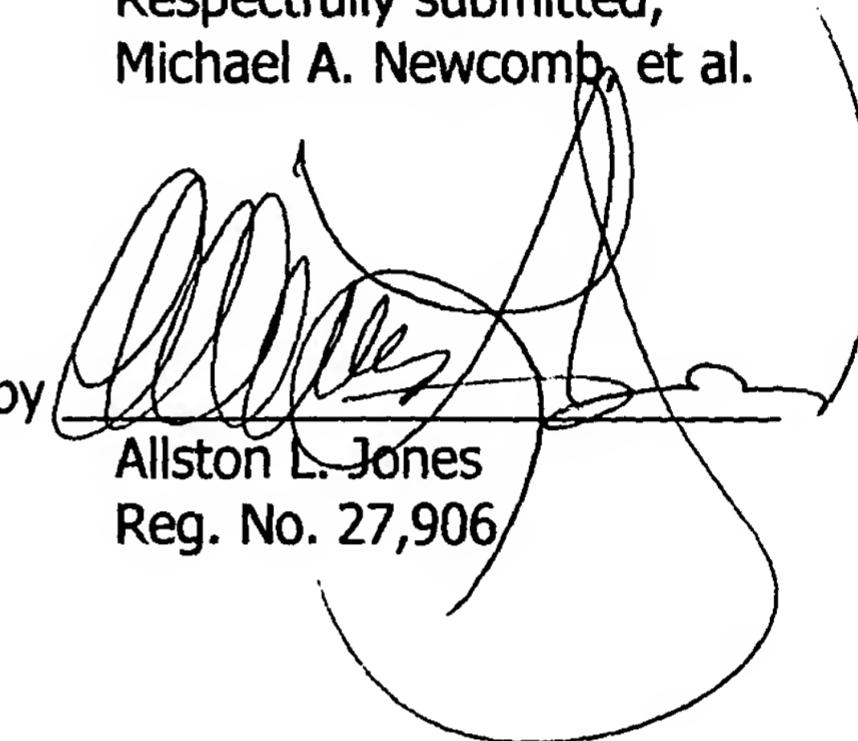
71. (new) A method according to claim 69, further including the step of using an image position monitor to measure changes in the image locations.

73. (new) A method according to claim 65, wherein the heating or cooling is carried out without significantly changing magnification of the optical system.

These claims are allowable in view of the art cited by the Examiner in the parent application. Allowance of the claims is therefore respectfully requested.

Favorable action is respectfully requested.

Respectfully submitted,
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